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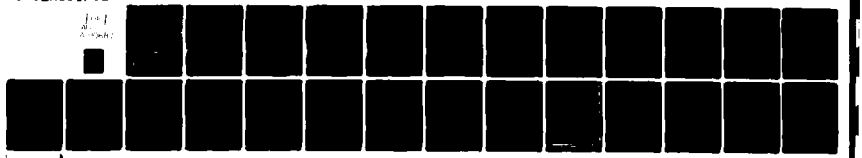

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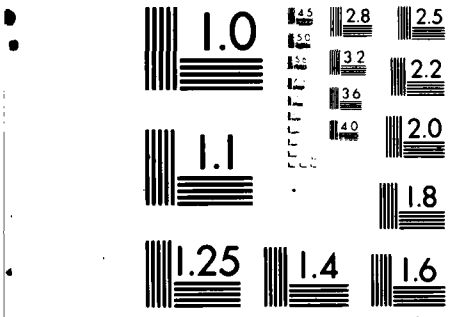

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THE UTILITY OF A GENERAL AVIATION TRAINER (GAT-1) IN THE T-41 PILOT INDOCTRINATION PROGRAM

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JULY 1981

DEAN OF THE FACULTY

UNITED STATES AIR FORCE ACADEMY

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The utility of a general aviation trainer (GAT-1) in the light aircraft pilot indoctrination program at the U.S. Air Force Academy was demonstrated using fifty-six Academy cadets as subjects in four groups: control, automated GAT instructions, delayed entry, and GAT training by an instructor pilot. The results indicate GAT-1 training greatly facilitated initial progress in the light aircraft flight instruction program, and that instructors working with the students in the CAT-1 can make reasonably good prediction of success

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in the flight program. The incorporation of such a device in the flight instruction program could enhance safety and result in monetary savings.

This research report is presented as a competent treatment of the subject, worthy of publication. The United States Air Force Academy vouches for the quality of the research, without necessarily endorsing the opinions and conclusions of the author.

This report has been cleared for open publication and/or public release by the appropriate Office of Information in accordance with AFR 190-17 and DODD 5230.0. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service.

This research report has been reviewed and is approved for publication.

Clayton V. Stewart

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Director of Research and Continuing Education

The Utility of a General Aviation Trainer (GAT-1) in the T-41 Pilot Indoctrination Program

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Abstract

The utility of a general aviation trainer (GAT-1) in the light aircraft pilot indoctrination program at the U.S. Air Force Academy was demonstrated using fifty-six Academy cadets as subjects in four groups: control, automated GAT instructions, delayed entry, and GAT training by an instructor pilot. The results indicate GAT-1 training greatly facilitated initial progress in the light aircraft flight instruction program, and that instructors working with the students in the GAT-1 can make reasonably good prediction of success in the flight program. The incorporation of such a device in the flight instruction program could enhance safety and result in monetary savings.

THE UTILITY OF A GENERAL AVIATION TRAINER (GAT-1) IN THE T-41 PILOT INDOCTRINATION PROGRAM

With the current fuel snortages and the inflation of costs in general, there has been much concern about the expenses in pilot trainee selection, flight training, and the education of Academy cadets (Gates, 1975; Orlansky and String, 1977).

The soaring costs of pilot training have provoked numerous ideas on how to reduce costs and still produce effective pilots for the U.S. Air Force. A Specialized Undergraduate Pilot Trainfng (SUPT) plan has been proposed to reduce costs and insure that the training of pilots will be optimized to emphasize the requisite skills for the type of aircraft to wnich they will be assigned upon completion of pilot training. A program such as SUPT mignt include light aircraft instruction (T-41) for general concepts of flight, a primary flying jet (T-37) for jet flight instruction and to determine the track to which the student might be assigned, and two basic flight aircraft: one for students destined for fighter-attack-reconnaissance aircraft and the other for those to be assigned to transport-tanker-bomber type of aircraft.

Another proposal to reduce costs for pilot training has been to delete the entire light aircraft instruction program and use a ground based screening (GBS) system to identify those candidates who have the greatest likelihood of success in pilot training (Hunter & Thompson, 1978). The GBS plan assumes that the light aircraft flight instruction program has minimal transfer effectiveness for subsequent flight training, that it is an inadequate screening device for identifying potentially

successful and unsuccessful pilot training students, and that it is a significant cost factor in the training of pilots. The motivational value of the Air Force having a light aircraft training program could not be clearly established, and thus it was not a significant factor in the proposal to implement a GBS program.

Another possible program would be to substitute some of the light aircraft flight instruction with instruction in a flight simulator resulting in reduced costs of the flight training program, reduced exposure to hazards while the trainee is at a low skill level, and more effective use of training time. All these advantages could be realized while maintaining the proficiency of pilots entering jet training at its present level, if not higher.

In 1971, Povenmire and Roscoe published results of a study on the transfer of training from a GAT-1 (General Aviation Trainer) to a light single engine aircraft (Piper Cherokee). They concluded: "General application of GAT-1 trainer time toward the flight experience requirement for private pilot certification appears warranted on a one-for-one basis up to some limit equal to or greater than 11 hours." (pg 115). Also, they indicated that the prediction of pilot training aptitude after only two hours of GAT-1 performance appeared promising ($r = 0.45$).

Flexman, et al (1972) demonstrated the transfer effectiveness of the Link SNJ simulator to the T-6 aircraft for both contact flight (VFR) and instrument flight (IFR). The transfer effectiveness ratios for VFR maneuvers was higher than for IFR maneuvers. The authors felt that this could have been because the VFR maneuvers were taught before the IFR maneuvers, and with the similarity between VFR and IFR performance there

would be less available to transfer to IFR maneuvers in the aircraft after the VFR maneuvers had been trained. Throughout all of the maneuvers, an hour of training in the simulator was worth at least a half-hour of flight training and in some instances up to an hour of flight training. In this study (Flexman, et al 1972) a rudimentary visual system, cyclorama (Valverde 1968), was used with the SNJ simulator. The cyclorama surrounds the simulator with a circular curtain or wall on which a horizon and some heading references are represented by pictures or symbols. The subject could have some extra-cockpit visual cues which are particularly useful in performing VFR maneuvers.

Long and Varney (1976) proposed the automated use of two GAT-1 trainers along with a computer for control and data acquisition for the prediction of pilot training success. This program, Automated Pilot Aptitude Measurement System (APAMS), offered the advantage of effectively training a candidate while measuring his rate of learning and actual performance on piloting tasks which were to be used as predictors of success-failure in pilot training.

For each of the subjects the APAMS would require five one-hour training sessions in which each would be automatically instructed on how to fly from basic maneuvers to traffic patterns that included takeoffs and landings. Their predictions of pilot training performance based on five factors from factor analysis of all the data collected was only fairly successful ($R = 0.51$) and needed to be cross validated. Since then, the estimated costs of maintaining and operating the APAMS as part of a nation-wide pilot screening program was deemed too costly, and research was initiated for the development of an inexpensive portable

device (PAPAMS) with the same goals as the APAMS.

The number of students registered for the T-41 training program at the Academy was so large that forty students were not able to start with the rest of the class at the beginning of the semester. The plan was to start those students who had already had some flying experience first, to get them through the program as soon as possible, and then train the forty unexperienced students.

The purpose of this study was to determine whether a delay of entry into the T-41 program would have an effect upon T-41 performance and to determine the effectiveness of the GAT-1 for training students on a portion of the required syllabus. Since the training filmstrips and tapes of the APAMS were available,, the study was designed to investigate the effectiveness of the programmed instruction of the APAMS as well as the effectiveness of GAT-1 instruction given by an instructor pilot. The initial proposal included the transfer effectiveness of the GAT-1 to the T-41, but due to circumstances after initiation of the study, proficiency advancement of the students was not feasible and the hours to solo was not attainable as a dependent variable.

METHOD

Subjects

Fifty-six pilot qualified first class cadets (seniors), registered in the T-41 flight training program at the Air Force Academy, participated in this study. None of the subjects had prior powered aircraft or glider flight training. Twenty-eight of the subjects were randomly selected from those who began the T-41 training at the beginning of the

semester (normal entry), and twenty-eight were randomly chosen from the forty who were designated for delayed beginning of the T-41 program (delayed entry). Each of these groups was divided in half. Fourteen of the normal entry cadets were given the five sessions of APAMS instruction in the GAT-1 before the semester began, experimental normal (EN), and fourteen served as normal entry controls, control normal (CN). Fourteen of the delayed entry cadets were given most of the first five hours of the T-41 training syllabus in the GAT-1 by a T-41 instructor pilot, experimental delayed (ED), and the remainder of the delayed subjects served as delayed controls, control delayed (CD). Subjects in the CN and CD groups were not aware their performance was being monitored as part of this study. Two subjects, one in the EN group and one from the CD group, dropped the T-41 program before their final check ride ride and thus reduced those groups to thirteen each.

Each of the seven instructor pilots (IP) in group ED was assigned two students and a class period in which they would give their GAT-1 instruction. The instructor pilots had not seen a GAT-1 trainer prior to this study, and they volunteered to take on the additional burden of the GAT-1 training.

Equipment

A Singer-Link GAT-1 (General Aviation Trainer) was used in the Behavioral Sciences Laboratory at the Air Force Academy. The GAT-1 trainer had been modified to fly similar to a Cessna 172 aircraft with respect to the power settings, airspeed, vertical velocity, and turn rates. For the EN group, the GAT had a Bell and Howell Film-O-Sound projector mounted in the left hand window to present the instructions to

the subjects via cassette tapes synchronized with film strips, and there was a television monitor mounted on top of the glare shield in the pilot's forward field of view. The monitor was used to give the EN subjects information as to their x-y position with respect to the runway and the desired pattern track. All other window areas for external visual cues were covered with black cloth to prevent visual cues from outside the GAT-1 cockpit. The film strips and instructional tapes were duplicated from those used in the original APAMS research (Long and Varney, 1977).

The ED group had its first training session with the GAT in the same configuration as group EN. Thereafter, the black cloth and the Film-O-Sound projector were removed from the windows, leaving only the TV monitor which partially blocked the subjects' forward field of view from within the cockpit. A cyclorama, circular cloth, was hung from the ceiling around the simulator so the subjects could not see the ceiling or the floor when operating the GAT. The cyclorama was blue and had a black stripe representing the horizon, and the letters N, S, E and W in the appropriate places on the horizon to represent the cardinal headings. The instructional syllabus used by the IPs was the same as that used for the first five hours of T-41 flight training.

Procedure

The subjects (Ss) in the NC and DC groups proceeded uninterrupted with their T-41 classes. The students in the (EN) group were given the five one-hour sessions in the GAT-1 using the APAMS film strips and cassette tapes. Because of class scheduling the sessions were separated by 48 to 96 hours and the GAT training was given in the semester prior to the T-41 training. The experimenter would set up the GAT conditions

for each of the sessions, monitor the student's performance on a remote indicator panel, and give verbal feedback whenever the subjects would exceed specified tolerances, a feature APAMS produced with a computer synthesized voice system.

The ED subjects reported in pairs with their IP to the GAT room where the IP pre-briefed the day's mission to both students in accordance with the syllabus requirements. Each flew the pre-briefed mission of approximately 45 minutes. While one S was flying the GAT, the non-flying S would monitor the flying S's performance at the remote indicator panel, and thus learn through observation. The IP rotated the Ss as to which was first each lesson. After completing daily instruction to both Ss, the IP thoroughly de-briefed each subject. Each period was approximately three hours long, allowing time for two 45-minute training flights, pre-briefing, and de-briefing. Each subject had seven such training sessions, totaling approximately five hours of GAT flight instruction.

After instructing his students in the GAT, the IP completed a questionnaire (Appendix A) which asked about the subjects' potential in the T-41 program overall, in the flight portion of the T-41 program, and about the GAT as a training device.

As slots in the T-41 program became available, one of a pair of ED subjects who had completed the GAT training entered the T-41 program with another IP and the remaining one entered the T-41 program with the IP who had given him the GAT training.

At the end of T-41 flight training, each student was given a flight check ride by a cadre of flight examiners who had not flown with the

students before and were not aware of the students' prior training in the GAT.

A student's performance on the check ride was scored on twenty-seven categories of maneuvers, procedures, and knowledge by checking each as unsatisfactory, fair, good or excellent, using an ATC Form 682 (Appendix B). An overall grade of satisfactory or unsatisfactory was also awarded.

RESULTS

Only two of the fifty-four students were eliminated from the T-41 program for flying training deficiencies, one from the EN group and one from the ED group; all others had an overall grade of qualified. To obtain a more meaningful overall check ride score, all blocks checked unsatisfactory were scored as zero, fair = 1, good = 2, and excellent = 3; and the average of all the blocks scored became the final check ride score. The scores ranged from 1.41 to 2.52 except for the two failures who were given an overall score of 1.00 each. The means and standard deviations of the four groups are given in Table 1. An analysis of variance showed no significant differences between the groups, $F(3,50) = 0.398$, $p > 0.75$, on the final check ride scores.

TABLE 1

Summary of the Final Check Ride Scores

	Normal Entry		Delayed Entry	
Group	Control	APAMS	Control	GAT-1 Tng
Mean	2.122	2.028	2.175	2.104
s. d.	0.190	0.428	0.289	0.435
N	14	13	13	14

The correlation between the instructors' estimates of the students' abilities to complete the T-41 program (both academics and flying together) and tneir final check ride scores, was $r = 0.267$, $p < 0.02$. The correlation between the estimate of the students' abilities to complete the flying portion of the T-41 program and their final check ride scores were $r = 0.749$, $p < 0.01$.

Overall, the subjective comments of the instructors about the value of the cyclorama, the GAT as a flight training device, and how to more effectively use the GAT were extremely favorable (Appendix C). Six of the seven IPs felt that using the cyclorama resulted in a marked improvement in the student's performance and helped in teaching the student to integrate the information from the instruments with the visual references of the outside world. The other IP felt the cyclorama didn't have much usefulness. All IPs were strongly favorable toward the GAT as a flight training device, and suggested improvement in its fidelity, and integration of GAT training with T-41 training instead of having a block of GAT training prior to the T-41 training.

DISCUSSION

From the statistical analysis it appears that neither the delay of entry into the T-41 or the training in the GAT had any effect upon the final check ride scores. Instructors' comments regarding the students who had GAT training indicated that at the beginning of T-41 training the subjects had the basic concepts and were familiar with the functions of the controls to the extent that hours of initial training could be saved. Unfortunately, the subjects had to go through each of the lessons

in the T-41 as prescribed by the syllabus and could not proficiency advance in the program, and all subjects had about the same number of flight hours when given their final check ride. Although there was no significant differences between those who had GAT training and those who had not, there was evidence that the GAT, if properly integrated into the T-41 program, could reduce some of the flight time to reach a given level of proficiency. The instructors' comments as to usefulness of the GAT were further reinforced by their requests to use the GAT to brush up on their own instrument flying skills since their T-41 flying was predominantly visual (VFR).

Another utility of the GAT demonstrated in this study was the ability to predict a subject's overall flight performance after observing just a few hours of his performance in the GAT. This information could be of value in identifying those weak subjects who might benefit from additional GAT training or more emphasis on training certain skills. The significant predictions made from the GAT to T-41 were better than most that have been reported in the literature to date, and if the criterion measure of T-41 performance could be refined, even better predictive validity could be expected.

Because the use of the GAT could result in a significant savings in T-41 flight time, a determination should be made as to the transfer effectiveness ratio of the GAT to the T-41 and the optimum mixing of trainer and aircraft time. Using the GAT in the flight training program would reduce costs without reducing the proficiency of those who complete the program. At the same time its use would benefit the students and the instructors by identifying those students who might have difficulty

in pilot training. Also, a more objective method of scoring check flight performance for the T-41 program should be developed, such as the Pilot Performance Record (Koonce, 1979), so that a more accurate and scoreable measure of the check flight can be made.

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APPENDIX A

QUESTIONNAIRE FOR INSTRUCTORS

QUESTIONNAIRE FOR INSTRUCTORS ON THE

GAT-1 to T-41 TRANSFER OF TRAINING PROGRAM

One questionnaire is to be completed for each student that you trained in the GAT-1 for this study.

1. Cadet Name _____
   Last First MI
   Cadet Number _____

2. What is your estimate of the cadet's ability to successfully complete the T-41 program?

Will not Complete	Poor	Below Average	Average	Above Average	Very Good	Excellent

3. What is this cadet's potential in the flying portion of the T-41 program?

Will Not Complete	Poor	Below Average	Average	Above Average	Very Good	Excellent

4. How many sorties in the T-41 do you feel this cadet will need to complete the program:

Less Than Average	Average	More Than Average

The following three questions are for the instructor to answer about his perceptions on the GAT program (please answer only once):

1. Do you have any comments about the value of the cyclorama (the curtain with the horizon and cardinal headings)?

2. Realizing that the GAT-1 was designed to fly as a Cessna 172 instead of a T-41, what are your feelings toward it as a flight training device?

3. In what way could the GAT-1 be more effectively utilized in its role as a training device?

APPENDIX B

ATC FORM 682

T-41 CONTACT CHECK GRADE SHEET

----, William H	CLASS 76-04	DATE 10 MAY 76

FINAL CHECK	U	F	G	E	REMARKS
Aircraft Preflight				X	
Takeoff / Traffic Exit		X			Poor directional control, descending T/O
Climb Climbing Turns			X		
Level Off				X	
Straight and Level			X		
Turns			X		
Steep Turns		X			Lost Alt on Lt. turn, gained Alt on rt turn
Coordination Exercise			X		
Slow Flight			X	|||	
Power-On Stalls			X		
Traffic Pattern Stalls				X	
Power Letdown				X	
Forced Landing			X		
Glides and Gliding Turns				X	
Traffic Entry			X		
Patterns		X			low A/S on base
Landing		X			high on final, angling final
Go-Around				X	
Local Area Procedures			X		
In-Flight Planning				X	
In-Flight Checks				X	
Clearing			X		
Radio Procedures			X		
Trim			X		
Throttle Use				X	
Ground Operating Procedure			X		
Emergency Procedures				X	
~~Over All Grade~~					
Comments		9	13	10	

DA 222

SIGNATURE OF INSTRUCTOR	SIGNATURE OF STUDENT
David L -----	William A. P -----

ATC FORM APR 76 682 PREVIOUS EDITION IS OBSOLETE. T-41 CONTACT CHECK GRADE SHEET (S-V8F-A)

APPENDIX C

INSTRUCTORS' RESPONSES TO QUESTIONS ABOUT THE GAT-1

Responses of Seven Instructor Pilots to Questions

on the GAT-1 to T-41 Transfer of Training

1. Do you have any comments about the value of the cyclorama (the curtain with the horizon and cardinal headings)?

   a. It improved aircraft control significantly and helped produce better cross check. Cardinal headings helped in maneuvers and clearing turns.

   b. A marked improvement in performance was noted after installation of the cyclorama. Provided additional visual references which students needed instead of only using instruments.

   c. The lack of it hurt more than anything originally. The first two rides flown in the black box, then it took two rides to adjust, the last rides showed marked improvement. The curtain in itself helped little because the TV box blocked a major portion of front viewing. The expenditure of $25-40 on an ultra-cyclorama would be beneficial.

   d. It helped the student not to depend upon the attitude indicator. Also gave him an idea of how the maneuver would look in the airplane.

   e. I don't feel that it had much usefulness.

   f. I feel that a visual reference is very helpful to the student. The curtain we used was helpful; however, in an extensive program, a more sophisticated visual reference would be necessary. But, what we had was beneficial.

   g. A necessity to train VFR in the GAT-1. VFR training is best adaptable to T-41 transition.

2. Realizing that the GAT-1 was designed to fly as a Cessna 172 instead of a T-41, what are your feelings toward it as a flight training device?

   a. Very effective in teaching maneuvers and procedures. Reacts enough like the T-41 to give the student a feel for the different aircraft attitudes.

   b. The GAT-1 is a valuable supplement to the T-41 training program primarily in introducing the student to flying without the pressure and apprehension associated with the first flights in the aircraft.

   c. Very acceptable.

d. It's a procedural trainer. Even if the airspeeds are different and it doesn't handle exactly like the T-41 doesn't really make any difference. The student does have to learn two different airspeeds, but it shouldn't pose a problem for a sharp AFA cadet.

e. Excellent.

f. I feel that a trainer like the GAT-1 would be beneficial for training if all control movements were realistic. Basically, the trainer feels realistic, but the roll aspect was not. It teaches the use of the instruments and with a visual reference could be beneficial in training students.

g. Very good for procedural training.

3. In what way could the GAT-1 be more effectively utilized in its role as a training device?

a. If the roll on the GAT-1 could be reduced it would be close enough to the real thing to reduce the number of rides (in the T-41) significantly.

b. As a training device it should be integrated into the T-41 syllabus. Probably 2-4 missions in the GAT-1 prior to flying the aircraft and 2-4 missions later in the program. Some reduction in aircraft time should be expected.

c. Correlate all airspeeds and altitudes to the T-41 flight line manual.

d. Set up a program that each cadet entering the T-41 program would get approximately 5 hours in the GAT-1 the semester before the T-41 program.

e. I think that it is fine the way it is.

f. I feel that a combination between the trainer and the airplane would be beneficial both in terms of training and costs.

g. Use it along with the T-41 instead of completely prior to T-41.

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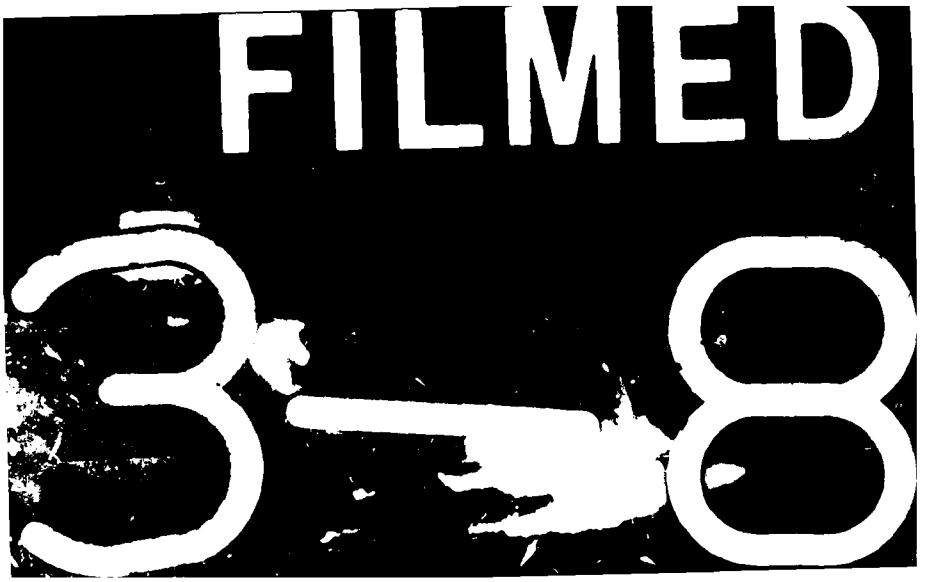
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